SECURITY SYSTEM FOR AN AUTOMATED TELLER MACHINE

CROSS-REFERENCE TO RELATED APPLICATION

The present application is a continuation-in-part of U.S. Patent Application Serial No. 08/508,918 for "IMPROVED SITE SECURITY SYSTEM" filed July 28, 1995, and U.S. Patent Application Serial No. 08/641,489 for "MOBILE, GROUND-BASED PLATFORM SECURITY SYSTEM" filed May 1, 1996, incorporated herein by this reference in their entirety.

FIELD OF THE INVENTION

This invention relates generally to the field of security systems for Automated Teller Machines (hereinafter ATMs) and, more particularly, to an inventive system for capturing optical images in response to the initiation of a transaction at the ATM, digitally storing the images for transaction-based, random access, and transferring the captured images to a remote location such that the images are viewable at the remote location. The system may also readily be configured to respond to alarm signals and/or other input signals and to provide a range of outputs including, for example, system status indications.

BACKGROUND OF THE INVENTION

The popularity and use of ATMs has grown at a rapid rate. In the fast paced, modern world, the convenience which is provided by these machines is greatly appreciated by the customers of a bank or other such financial institution. However, in providing ATMs, the bank and its customers are exposed to significant security risks, as will be described.

One risk relates to fraudulent card use. For example, a stolen card may be used by an unidentified person in an attempt to withdraw money from the account of a bank customer. In such an instance, the bank and law enforcement authorities are interested in information which may identify the person attempting the illegal transaction.

Another risk is claims by customers that they did not make a particular transaction, even though the transaction in question was properly recorded against a customer's account and the card was not lost or stolen. In such a case, the customer possibly made the transaction and then simply forgot about it. Alternatively, a member of the customer's immediate family may have borrowed the card and originated the

transaction without telling the customer. Either way, the bank would find information establishing the identity of the person initiating the transaction as being of great value.

Still another risk relates to physical protection of the ATM. Aside from the money which the ATM contains, there is a considerable investment in the machine itself. Since most ATMs are generally unattended and are open 24 hours a day, there are potentially many times during the course of a day or night when the machine goes unobserved for substantial periods of time. It is during these times that the machine is most exposed to incurring loss/damages from theft and/or vandalism. Incontrovertible evidence, following a loss, which leads to the identification of any persons responsible for such damage or theft would be extremely valuable to the bank and to law enforcement officials. Furthermore, ATMs require service at frequent intervals during which maintenance personnel typically have access to all areas of the machine. Even though maintenance personnel are generally honest, just one unscrupulous maintenance person may cause considerable loss by inflicting damage on the machine or by stealing its funds. To reduce such risks, the presence of a security system which provides evidence as to the identity of any person committing such acts would be particularly useful as a deterrence.

In an attempt to address such risks, prior approaches utilize a videotape recording system which is located at the ATM site. This system detects a transaction initiated at the ATM and then records one or more frames of analog video information of the person initiating the transaction on videotape. While this system will provide an image of the person initiating the transaction, it is subject to the limitations that are imposed by an analog videotape system. For example, videotape does not provide for ready, selective access to the images recorded thereon. Locating a particular recorded image may require an arduous, time consuming review of the contents of the tape. Further, the system does not readily provide for immediate or meaningful response to, for example, a theft by way of unauthorized access to the ATMs safe or to the use of a stolen card.

SUMMARY OF THE INVENTION

In view of the foregoing, the present invention represents a significant improvement in the art by virtue of its ability to provide the following:

- A security system for an ATM that captures/digitally stores images in corresponding relation to a triggering transaction and/or responsive to an alarm input.

- A security system for an ATM that readily transfers/captures images from the ATM to at least one remote location wherein the images are viewable at the remote location.

- A security system for an ATM that does not impede the normal processing of transactions carried out by the ATM.

- A security system for an ATM that digitally stores captured images on removable media at the ATM such that the removable media can be transported to a remote location where the images may be selectively viewed via random access at the remote location.

One or more of the above benefits are addressed by the inventive security system for an ATM described herein. The ATM is connected to and cooperates with an ATM network for processing a transaction initiated at the ATM by a person The security system generally includes at least one image capture unit or camera at the ATM for capturing at least one image of the person, storage media for digitally storing images captured by the camera, and means for transferring the images from the imaging means to image storage media for storage as digitized image data and from the imaging means to at least one remote location wherein the images are viewable at the remote location.

In one aspect of the present invention, the image is captured as electrical pixel signals utilizing, e.g., a CCD camera board or on-chip arrangement, thus facilitating efficient digitization, transfer and image data storage. Either color or black and white cameras may be used. CCD cameras can provide a variable image resolution that is selectable. Resolution can be controlled by appropriate application of voltages to electrodes of the CCD chip during image capture. Relatedly, the cameras may continuously capture images. A predetermined number of these images may be temporarily stored by the camera or by storage media. At completion of capture of a new image, the oldest temporarily stored image may be replaced by the new image. When an alarm or transaction event occurs, the temporarily stored images comprise pre-event images. In one feature, the system may be configured such that a particular camera then captures a predetermined number of post-event images. Thereafter, pre-event and post-event images may be digitally stored, in relation to that particular transaction or alarm event, at the ATM and/or immediately transferred to the remote monitoring station. This

latter feature advantageously permits the system operator to see the state of the monitored area or zone before, during and after the actual event.

In another aspect of the present invention, the storage media may comprise a hard drive which stores images in a non-volatile manner. Relatedly, the image transfer means includes removable storage media which may be removed from the ATM and transported to the remote location whereby to accomplish transfer of the images. The images may then be viewed at the remote location in a way which provides random access to the images.

As can be appreciated, viewing transferred images using a random access format allows an operator to perform searches based on parameters associated with a transaction or alarm event. Such parameters include, but are not limited to, the transaction number, the account number, the amount and the date and time at which the transaction or alarm event occurred.

In another aspect of the present invention, transaction information is obtained from the ATM network during processing of the transaction. The transaction information is stored in a way which correlates the transaction information with one or more images which are captured and digitally stored responsive to the transaction processing. In one feature, the transaction information and the transaction images are stored in separate, but associated file locations such that images may be located by searching the stored transaction data without searching the stored image data. In one embodiment incorporating this feature, the transaction and image files are correlated using their respective file names. Accordingly, a search may identify a particular transaction file by locating therein, for example, an account number or transaction number. Once the transaction file is identified, the name of that transaction file is in a format which specifically identifies all images correlated therewith such that the system may directly retrieve the image files. In another embodiment, the transaction information and image information are stored in a first file and a control index table is stored in a second file. The control index table includes certain portions of the transaction information for each transaction, correlated with the specific location of the transaction information within the first file.

In another aspect of the present invention, the system responds to specific data which may form part of the transaction data by transferring one or more transaction

images to the remote monitoring station when that specific data is identified. In one embodiment, the system can be configured to respond in this way to an account number which is obtained from the ATM network upon initiation of a transaction by a customer at the ATM. In another embodiment, the system responds to data obtained from the ATM network which indicates that a cash withdrawal transaction currently being processed, i.e., the person initiating the transaction is present at the ATM, is of an amount which is greater than a predetermined threshold amount. Response may include the immediate transfer of images to the remote monitoring station.

In another aspect of the invention, the system is configured to respond to one or more inputs wherein the input may trigger the capture of images or wherein the system may respond to the input by providing indications or by actuating a particular device. As can be appreciated, image capture in accordance with this aspect may be triggered by inputs such as intrusion sensors or motion detectors. An intrusion sensor may monitor a door such as a vault door. In one embodiment, the intrusion sensor outputs a signal directly to a camera which captures an image of the area of the subject door if the latter is opened. In one feature, these images are stored at the ATM and transmitted to the remote monitoring station at a convenient time for review by security personnel. In another feature, these images are stored at the ATM and promptly transferred to the remote monitoring station for immediate review. In another embodiment, the system provides an output signal responsive to the input signal. The input signal can be provided by an intrusion sensor or other such device. In this case, the output signal may be used to actuate an alarm bell. In still another embodiment, the input signal arms or disarms a security section which comprises one or more cameras that are responsive to signals other than the initiation of transactions. The input signal can be provided from a device such as a key switch at the ATM and/or from the remote monitoring station via telephone line.

In another aspect of the present invention, the system monitors at least one of its elements and provides an output indication responsive to the status of the monitored element. As will be appreciated, virtually any element of the system may be monitored in this way. In one embodiment, the system includes either permanent or removable storage media as the monitored element. The output indication is provided in the form of an illuminated indication lamp at the ATM responsive to image storage media being

filled to a predetermined image storage capacity. In another embodiment, a watchdog module monitors the overall security system at the ATM to insure that it has not "locked up." The watch dog module includes a timer which is automatically reset at regular intervals. In the event that the timer "times out," the system is automatically rebooted by the watch dog module. In one feature, after rebooting, the remote monitoring station is notified that a system malfunction occurred.

In yet another aspect of the present invention, each camera digitizes and compresses the electrical pixel signals for an image before the image is transferred. Once the images are transferred to the remote location they are subsequently decompressed for display to an operator. In this manner, the physical amount of data required to transmit an image(s) is decreased and the corresponding time required to transfer the image(s) is thereby decreased.

In a further aspect of the present invention, each camera digitizes and compresses the image data, as in the above-noted aspect, and further includes compression identification information with the transmitted image data. The monitoring station decompresses the image data responsive to the compression identification information. In one embodiment, the monitoring station includes a plurality of decompression algorithms with one of the decompression algorithms being selected for use in decompressing the image data by the associated compression identification information. In another embodiment, the compression identification information includes information that is used by the decompression algorithm to decompress the corresponding image data. For example, for systems having variable image resolutions, the compression identification information can include a compression table that is generated by a camera for image data having a selected image resolution. The compression table is transmitted along with the associated image data to the remote location for use in a decompression algorithm during decompression of the image data.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and further advantages thereof, reference is now made to the following Detailed Description, taken in conjunction with the Drawings, in which:

FIG. 1 is an explanatory diagram illustrating a first embodiment of a security system for use in capturing optical images in areas associated with an ATM and for transferring the images to a remote location in one of several different ways.

FIG. 2 is a block diagram illustrating the components which make up the embodiment of the system of FIG. 1 at the ATM and at the remote monitoring station.

FIG. 3 is a flow chart describing and showing the system of the present invention in accordance with the first embodiment.

FIG. 4 is an explanatory diagram illustrating a second embodiment of a security system for use in capturing optical images in areas associated with an ATM and for transferring the images to a remote location in one of several different ways.

FIG. 5 is a block diagram illustrating the components which make up the second embodiment of the system in FIG. 4 at the ATM and at the remote monitoring station.

FIG. 6 is a chart illustrating a directory tree used for storing image data in accordance with a directory structure utilized by the second embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Attention is immediately directed to FIG. 1 which illustrates a diagrammatic plan view of a security system, generally indicated by reference numeral 50, constructed in accordance with the present invention. System 50 monitors an ATM 52 housed in a structure 54. Structure 54 includes a customer access door 56 which provides access to a customer lobby 58. Since most ATMs are open 24 hours, customer access door 56 is normally unlocked, however, in some applications it may be desirable to lock this door during certain time periods. A service door 60 provides access to a maintenance area 62. Service door 60 is normally closed and locked unless it is being used by service personnel, however, it is shown in its opened position in the present example for illustrative purposes.

ATM 52 includes a customer console 64 at which a customer may insert an appropriate card (not shown) into a slot 66 whereby to initiate a transaction on ATM 52. Transactions are conducted by the ATM in cooperation with an ATM network (not shown) to which ATM 52 is connected via a network modem 68 and a network cable 70 dedicated to servicing the ATM. Network cable 70 leaves structure 54 in an underground

conduit 72 in order to prevent unauthorized access to the network cable and any other critical cables. The outward appearance of ATM 52 may take on many different configurations. Functionally, however, ATMs are generally very similar in that they communicate with the ATM network so as to allow customers to perform typical transactions such as, for example, deposits to savings or checking accounts and cash withdrawals. In a typical ATM, the customer interacts with a display screen 74 and a plurality of buttons 76 which are associated with the display screen. The initiation of a cash withdrawal transaction by a customer, of course, necessitates that ATM 52 dispense funds to customers. To that end, a vault 78 stores money 80 which may be provided to a customer from a dispenser slot 82 on customer console 64 in a manner which is well known to those familiar with ATM operation. Vault 78 includes an access door 84 which opens to maintenance area 62 and which is typically in a closed and locked position, but is shown in its opened position for purposes of illustration.

Still referring to FIG. 1, system 50 includes four electronic cameras 90a, 90b, 90c and 90d which capture images of zones 92a, 92b, 92c and 92d, respectively. Cameras 90a and 90b form part of a transaction monitoring section of system 50 while cameras 90c and 90d form part of alarm event monitoring section of the system. It should be noted that the system can readily be provided with or without the alarm monitoring section dependent upon a particular application. Camera 90a is mounted at customer console 64 for providing an image from the console of the face of a person standing in zone 92a directly before the console during a transaction. Typically camera 90a is hidden from the view of customers in a well known manner by, for example, being concealed behind a plastic panel which is specifically configured for that purpose. Due to its well-concealed location and close proximity to persons initiating transactions, images provided by camera 90a are typically very useful. Camera 90b provides an image of zone 92b which is a general view of customer lobby 58 towards customer console 64. Camera 90c is positioned for providing images of maintenance area 62 towards vault 78 and the remainder of the ATM equipment which is accessible from maintenance area 62. Camera 90d is positioned for imaging maintenance area 62 towards service door 60 and anyone entering this door. Cameras 90b, 90c and 90d are each housed in housings 94b, 94c and 94d, respectively. For illustrative purposes, the sizes of these housings have been exaggerated. Such housings normally permit the cameras to be concealed from obvious

view whereby to protect the cameras from vandalism or from a person who wishes to disable the cameras in order to prevent further image capture. It should be appreciated that the arrangement and number of cameras may be modified in an unlimited number of ways within the scope of the present invention and that the depicted arrangement is shown for illustrative purposes. Furthermore, the arrangement and number of cameras at a particular site will depend on the configuration of the site itself in conjunction with application specific monitoring considerations. It should also be appreciated that the system is configured to respond rapidly to events which trigger the capture of images. For example, if an alarm event and a transaction occur at essentially the same time, the cameras independently capture images. In this way, images are captured immediately after the occurrence of each triggering event.

System 50 further includes, a component enclosure 96, which is installed at a suitable location within the ATM site and a remote monitoring station 98 at a remote location. For purposes of clarity, component enclosure 96 is shown positioned directly adjacent an ATM electronics package 100. A network interface module 101, which will be described at an appropriate point below, is spliced into a network data cable 102 which interconnects the ATM electronics package with network modem 68. Even though component enclosure 96 is shown adjacent ATM electronics package 100, other locations may also be found to be suitable. For example, even in cases where the component enclosure is designed to be tamper resistant, access to the enclosure by unauthorized persons should be limited whenever possible. To that end, enclosure 96 includes a door 103 with a lock 104 whereby to permit controlled access to the interior of enclosure 96 by authorized personnel only. A plurality of RS-485 data cables 105 interconnects cameras 90 with component enclosure 96. The sizes of enclosure 96 and of cables 105 have been exaggerated for illustrative purposes. Moreover, these cables, as with all components of the system located at the ATM, should be hidden and/or arranged in a way which avoids unauthorized access thereto. Cables 105 are only partially shown for purposes of simplicity and since they are readily provided.

Still further components of the system include two intrusion sensors 106 and 107 which are positioned to monitor service door 60 and vault access door 84, respectively. These sensors are of a type which are well known in the art and typically include magnetic members, 106a and 107a, mounted on the door and sensing members, 106b and

107b, mounted on the frame of their respective doors. The sensing members sense the magnetic fields from their associated magnets when the doors are in their closed positions using, for example, reed switches in the sensing members which close or open a pair of contacts in the presence of the magnetic field. The signal from each sensing member is coupled directly to a respective camera 90c or 90d, as will be described. Many other types of sensors known in the art for sensing the position of a door or window are suitable for use with the present invention. In fact, system 50 is adaptable for use with virtually all types of sensors including, but not limited to, motion detectors and smoke alarms. A remotely actuable locking mechanism 108 is attached to customer service door 60. Remote lock 108 is of a type which is well known in the art. As noted previously, this lock is useful in denying customer access to the ATM during certain hours, for example, when the machine is out of service or closed. In addition, remote lock 108 may be provided with a card reader (not shown) into which a customer inserts his or her card. The card reader reads a magnetic strip on the card and, upon verification of predetermined parameters read from the magnetic strip, unlocks lock 108. Thus, security is enhanced by permitting only card holders to enter the ATM customer lobby. An alarm bell 109, also of a standard type, is located on the exterior of structure 54 at a position which is generally inaccessible. A key switch 110 is positioned on the exterior of the ATM structure adjacent service door 60. Components including remote lock 108, alarm bell 109 and key switch 110 are connected with component enclosure 96 using appropriate and readily providable cables. These cables are not shown in the present figure for purposes of simplicity. At this time, however, it is sufficient to note that these cables, as with many other cables at an ATM site, should be hidden whereby to prevent unauthorized access. As a further precaution, such cables may also incorporate protective jacketing which resists severing.

Continuing to refer to FIG. 1, remote monitoring station 98 includes a display monitor 113, a keyboard 114, a computer 116 and a modem 118 connected with a standard telephone line 119 which is, in turn connected with a standard switched telephone network. A printer 121 is also connected with computer 116. The printer should be of a type which is capable of printing text or high resolution graphics for image reproduction. Alternatively, two printers (not shown) may be used wherein one printer is dedicated to textual printing and the other printer is dedicated to rendering image data.

The latter may be a standard personal computer and includes a mass memory 122, I/O circuitry 124, a CPU 126, and a memory 128. An image transfer/search program 130, which is designed in accordance with the present invention, is stored in mass memory 122. A removable hard drive bay 132 is accessible from the front of computer 116 and is configured to receive an appropriate removable hard drive. The components which make up computer 116 are interconnected in a standard way, as is well known in the art, using data busses which are not shown for purposes of simplicity. A monitoring station operator 134 is seated at monitoring station 98. The operation of image transfer/search program 130 will be described later in conjunction with a general discussion of the overall operational features of the present invention. It is to be understood that the configuration of remote monitoring station 98 can be modified in an unlimited number of ways within the scope of the invention and that this specific configuration is shown for illustrative purposes only.

Having generally described the components which make up system 50 of the present invention, attention is now directed to FIG. 2 in conjunction with FIG. 1. FIG 2 illustrates, in diagrammatic block diagram form, the internal components of enclosure 96 and the interconnections formed between the components which are located at ATM 52. Each camera 90 includes a respective image capture section 138a, b, c and d, a respective processing section 139a, b, c and d, and a respective temporary image storage section 140a, b, c and d. It should be appreciated that cameras 90 may be configured and interfaced with the system in an unlimited number of ways in accordance with the present invention. For example, temporary image storage section 140 for each camera may be located at other points within the system. Images are digitally captured by the cameras. That is, these cameras transduce the images to the form of electrical pixel signals, convert the electrical pixel signals to a digital format and store the digitized images. Before storage or transmission, the digitized images can be compressed in accordance with a number of formats, several of which will be described below. It should be understood that image compression is useful in increasing the rate at which images may be transmitted and in conserving space on digital storage media such as, for example, a fixed disk. One type of camera which is particularly useful in the present application is a solid state CCD camera. One advantage of CCD cameras, in addition to being solid state, resides in the fact that captured image resolution is readily controllable by the proper

application of voltages to the electrodes of the CCD chip itself, as is known to those of ordinary skill in the art. CCD cameras, as well as other camera types, capture light in individual picture elements or pixels. In the present example, the pixels are arranged in the form of an array of 320 by 240 pixels for the highest resolution images which can be captured. However, much lower resolutions may readily be achieved by the CCD cameras, as noted above. An array of 156 by 100 pixels may be captured to comprise a medium resolution image or an array of 80 by 48 pixels may be captured to comprise a low resolution image. It should be appreciated that a range of image resolutions facilitates optimization of high transmission throughput (since lower resolution images contain less data), providing the highest image quality or a combination thereof. It should be appreciated that the digital format provides for a wide variety of image processing options which are well known to those having ordinary skill in the art and which are continuously undergoing improvement. For example, digitized images may be enlarged, reduced and enhanced in a wide variety of ways.

With continuing reference to FIGS. 1 and 2, RS-485 data lines 105 are, in turn, connected with a bi-directional RS-232 to RS-485 converter 144. The latter converts the standard full duplex RS-232 COM 2 interface of a personal computer 146 to a fully bi-directional half duplex RS-485 interface in order to enable communication from computer 146 to the cameras and, conversely, from the cameras to computer 146. Typically, each camera is assigned a unique address within a predetermined range of possible addresses. The camera address may be set, for example, by a set of DIP switches located in each camera. Any communications transmitted through the RS-485/RS-232 interface to or from a respective camera will contain that camera's unique address. The cameras are addressed as 1 through 4, as shown in FIG. 2.

The variable image resolution provided by the cameras is selectable by software commands from personal computer 146. In the case of CCD cameras, the variable image resolution may be achieved as described above. However, variable image resolution may be achieved in many other ways. As one example, processing section 139 at each camera may select a subset of the full array (320 by 240 pixels) of image data for each image to provide the selected image resolution. Processing section 139 compresses the image data before it is transmitted to personal computer 104. The compressed image data is subsequently decompressed for viewing at the remote monitoring station. One or more

data compression/decompression algorithms can be included in image processing sections 139 and in computer 116. Like the image resolution, the compression algorithm used by processing section 139 is selectable by a command from personal computer 146. The image processing portion includes compression identification information with the compressed image data that selects the decompression algorithm used by computer 116 to decompress the image at the remote location.

The compression/decompression algorithm can include a differential pulse-code modulation (DPCM) standard algorithm. For DPCM compression, the image processing portion transmits substantially all of the image data in the first image transmitted and, thereafter, transmits only the image data that changes in subsequent images. Alternatively, the compression/decompression algorithm can be a discrete cosine transformation (DCT) compression algorithm with run length encoding (RLE) data reduction or a Huffman algorithm such as used in the Joint Photographic Experts Group (JPEG) standard. However, according to the present invention, the data compression/decompression algorithms are adapted to support the variable image resolutions as provided by processing sections 139. In one such adaptation, the image processing portion transmits compression identification information that includes information developed by the compression algorithm for image data having a selected image resolution. The compression identification information is used by the decompression algorithm in computer 116 to decompress the transmitted image data.

Continuing to refer to FIGS. 1 and 2, a main hard drive 148 and a removable hard drive 150 are interfaced with personal computer 146. Removable hard drive 148 is positioned within enclosure 96 so as to facilitate its removal through door 103. Main hard drive 148 stores a basic operating system 152, a software control program 154 for controlling the overall operation of system 50, a group of transaction data files 156 and a group of digital transaction image files 158. Each transaction image file 158 is derived from an image initially captured by either transaction monitoring camera 90a or 90b and, thereafter, converted to digital form for transfer to main hard drive 148. The transaction data file group contains transaction data files which are associated with the digital image files contained by the image file group. It is noted that the association between the image and transaction files is maintained in a highly advantageous way through the use of the file names that are assigned to each type of file, as will be described. With regard to

image data file group 158 and transaction data file group 156. an identical file structure is maintained on removable hard drive 150. Specific details of the operation of software control program 154 including a discussion of the way in which image transfer from cameras 90 to the drives may be accomplished will be provided at an appropriate point below in conjunction with an overall discussion of system operation. Initially, however, system operations will be described in general terms whereby to facilitate a basic understanding by the reader.

It should be appreciated that the total number of images storable by each of the main and removable hard drives is determined by a number of factors such as, for example, the number of pixels for which corresponding digital data is stored per image and the physical storage size in megabytes of the respective drives. As an example, a 120 megabyte hard drive is capable of storing approximately 8000 images wherein each image is represented digital data corresponding to pixel arrays of 320 by 240. Various sizes of hard drives may be utilized in implementing the system based upon specific operational parameters, as determined for a particular system. Generally, main hard drive 148 is capable of storing more images than removable hard drive 150. Therefore, the main hard drive may contain some images which are not present on the removable hard drive.

With continuing reference to FIGS. 1 and 2, an input/output module (hereinafter I/O module) 160 handles inputs and provides outputs for controlling the system. I/O module 160 is connected to printer port LPT1 of personal computer 146 by a data cable 162. One input to module 160 is provided in the form of an arm/disarm signal on line 164. This signal in one embodiment is provided from key switch 110 which is located adjacent service door 60. Another input is provided by a switch closure from a card insertion sensor 165 (FIG. 2). The latter closes upon insertion of a card into slot 66 on the front panel of the ATM. I/O module 160, in the present example, is configured to provide three different outputs. Specifically, line 166 outputs a signal which illuminates an indicator lamp 168 responsive to removable hard drive 150 being filled to its storage capacity. Lamp 168 will normally be mounted on component enclosure 96 in a conspicuous location so as to be noticed during servicing of the ATM. Another line 170 is connected from I/O module 160 to alarm bell 109 whereby to activate the latter in the event of unauthorized access, for example, to maintenance area 62 or vault 78 responsive

to intrusion sensors 106 and/or 107. This alarm activation feature is useful, for example, during hours when the ATM is not typically serviced, such as at night. Still another output is provided from a line 172 which is connected with remotely actuable lock 108. A discussion of system operation with regard to the arm/disable signal, actuation of the alarm and remote lock features will be provided at appropriate points below. It is to be understood that, while these particular inputs and outputs are of significant value, the system of the present invention is configured to provide a great deal of flexibility with regard to its I/O capabilities. In this way, the system can be readily configured to accommodate a wide range of I/O applications.

Previously mentioned network interface module 101 is connected to COM 1 of personal computer 146 a line 178. Once a transaction is initiated at customer console 64 of the ATM, information is transferred between the ATM and the ATM network via network modem 68. During this transfer, information such as, for example, the customer's account number, the transaction number, the transaction amount, the type of transaction and the date and time at which the transaction was initiated are placed on network data line 102. Network interface module 101 detects this information and provides it to COM 1 of personal computer 146 via line 178. Personal computer 146 then stores all or preselected portions of this information in a transaction data file which forms part of transaction data file group 156 on both main hard drive 148 and removable hard drive 150. A modem 180 is interfaced with serial port COM 3 of personal computer 146 via an RS-232 data line 182. The modem is then connected with a dedicated telephone line 184 for providing communication with remote monitoring station 98. Since telephone line 184 is of critical importance, it leaves the ATM site via underground conduit 72 and is connected with switched telephone network 120. It is to be understood that wireless communication may readily be used as an alternative to switched telephone network 120. For example, the system may be implemented using a cellular telephone transceiver. Previously described sensing members 107b and 106b are connected to respective cameras 90c or 90d by cables 186 and 188, as shown in FIG. 2. Responsive to a signal on cable 186 or 188 caused, for example, by a contact closure in sensing member 106b or 107b, when either service door 60 or vault door 78 is opened, the associated camera is triggered or forced to capture at least one alarm image of its associated zone. Alarm images are stored on main hard drive 148 in an alarm image file

group 190. As with the previously described transaction images, each alarm image is stored in a file within alarm image file group 190 which is named using a particular advantageous format which incorporates the date and time at which the image was captured as an integral part of the file name. This format will be described in conjunction with a discussion of the transaction file name format at an appropriate point below. Alarm image file group 190, like transaction file group 158, is also recorded on removable hard drive 150. Alarm and transaction images may be transferred to monitoring station 98 in a number of different ways, as will be described.

Turning now to a general discussion of system operations and as mentioned above, the initiation of a transaction is detected by network interface module 101. Upon transaction detection, software control program 154 prepares files on the main and removable hard drives for storing both the transaction information and the images which are being captured. Thereafter, program 154 produces software commands selectively addressing and instructing cameras 90a and 90b to capture transaction images in digital electrical pixel signal form. The cameras may be instructed to capture one or more transaction images or, in a particular application, only one of the cameras may be instructed to capture one or more transaction images, as specified by software command. It should be understood that cameras 90 which capture transaction images may continuously capture and store images. For example, each camera may be configured to store four images such that the oldest image is continually being replaced by a newer image. Thus, in response to initiation of a transaction, a particular camera may capture two new images immediately following transaction initiation while continuing to store the two newest images which were captured prior to initiation of the transaction. These four images may then be stored on the hard drives or transferred to the remote monitoring station. In this manner, the system advantageously provides the operator with the ability to see images recorded before, during and after the initiation of the transaction. Alternatively, the system may instruct the transaction cameras to continuously capture images and the system may temporarily store these images on either the main or removable hard drive (as opposed to storage by temporary image storage sections 140). Once a transaction is initiated, the temporarily stored images are readily available on the drive as pre-event images. These pre-event images are then stored on the hard drive(s), in accordance with the file structure, as transaction image files correlated with that

transaction along with post-event transaction image files. It is noted that the transaction images (post-event) may not be immediately available following issuance of the software commands since the image data must be processed, for example, compressed and then stored in temporary image storage sections 140. Therefore, in one alternative embodiment, these commands may be issued prior to creating the appropriate files. The specific file-naming formats used on the main and removable hard drives will be described immediately hereinafter.

As with all operations performed by system 50, the network interface module obtains transaction information directly from the network in an autonomous manner which does not affect the operation of the network. The transaction data file is named using a date/time stamp. In one embodiment, the date/time stamp is obtained from the standard clock which forms part of personal computer 146. This feature is particularly useful when initiation of a transaction is detected by card insertion sensor 165 in the instance where information is not available from the ATM network due, for example, to incompatibility. In another embodiment, the date/time stamp is created from the transaction information provided by network interface module 101. Other relevant information is then incorporated into the file name along with the date/time stamp. Any other desired pieces of information such as, for example, the customer's name, the transaction number, the account number, the type of transaction and its amount may be stored as digital data within the transaction data file itself such that all of the information relating to each transaction is available for searching. The following format is used for the transaction data file name:

C:\DATA\YYYYMMDD\HHMMC.TRN

wherein C:\DATA\ is the directory on the main hard drive in which the file is stored. Succeeding information then comprises the date/time stamp wherein "YYYY" indicates the year, "MM" indicates the month, HHMM is the time in hours and minutes based upon a twenty-four hour clock. Next, "C" indicates the ATM number which can range from A to Z ("A" will be used in the following examples for purposes of simplicity) and CMP is the file extension which is unique to a transaction file.

Accordingly, a transaction file for images captured at 22:19 (10:19 p.m.) on March 25, 1996 would be named:

C:\DATA\19960325\2219A.TRN

The corresponding file on removable hard drive 150 (drive "D" in the present example) will be identical to the name immediately above except that the initial "C" is replaced with a "D".

The associated transaction image data files are named using the format:

C:\DATA\YYYYMMDD\HHMMCn.CMP

Comparison with the format above reveals the addition of "n" which indicates the camera address, as described above, and that the file extension has been changed to "CMP" which is indicative of compressed image files. In a case where a camera is instructed to capture two or more images for one transaction, these images are all stored in one transaction image file denoting that camera's address number in the file name. In this way, all of the images in the file remain properly associated with the correct transaction data file. Accordingly, transaction image files corresponding to images captured by cameras 90a and 90b (cameras 1 and 2, respectively) associated with the exemplary transaction file name above would be:

C:\DATA\19960325\2219A1.CMP, and

C:\DATA\19960325\2219A2.CMP

Once transaction images are processed and available, they are downloaded from temporary storage sections 140 through RS-485 bus cables 105 and converter 144 to personal computer 146. The latter then stores the images in digital form in image group 156 on each of the main and removable hard drives. The number of captured images per camera may be set from 0 to 5, as desired. It should be noted that setting a camera to capture no images effectively disables that camera.

Alarm image files are named in a manner consistent with transaction files except, of course, there is no corresponding transaction file, since information for alarm image files cannot be obtained from the ATM network. Accordingly, an alarm image captured by camera 90c (camera 3) at 13:40 (1:40 p.m.) on April 3, 1996 and stored on main hard drive 148 would be named:

C:\DATA\19960403\1340A3.CMP

As above, corresponding file names may derived for removable hard drive 150 by replacing the leading "C" with a "D". Furthermore, when a camera is instructed to capture multiple images, these images are stored in a single alarm image file. One of ordinary skill in the art will appreciate that this file structure may be modified in any

number of ways while continuing to embody the concepts of the present invention. Additionally, this file structure is readily adaptable for use on systems which use operating systems other than DOS.

In the present example, alarm images are captured by cameras 90c and 90d, which comprise part of the alarm reporting section of system 50. In one embodiment, this alarm reporting section is armed or disarmed responsive to key switch 110 and/or from remote monitoring station 98. As previously described, capture of alarm images by these cameras is triggered responsive to intrusion sensors 106 and 107 which monitor service door 60 and vault 78, respectively. A signal from one of these sensors causes its associated camera to immediately begin capturing one or more alarm images. It should be understood that cameras which are part of the alarm reporting section, like the cameras which capture transaction images, may continuously capture images for temporary storage either at the camera or on the hard drive(s) so as to provide the previously described advantage of seeing the condition of the monitored zone before, during and after receipt of the alarm event. Software control program 154 routinely checks these cameras whereby to ascertain whether alarm image capture is underway or whether images are compressed and ready for transfer to the main and removable drives. Once alarm images are ready, they are then stored in alarm image data files in file group 190 along with alarm image data files corresponding to a specified number (if any) of pre-event images in accordance with the file-naming format described above. System 50 may be configured for handling the alarm images in a variety of different ways after storage, as will be described at an appropriate point below. In another embodiment, the cameras may be instructed to capture images at a predetermined interval during periods of inactivity. This surveillance feature may, of course, be interrupted by other system activities such as the receipt of alarm or transaction events.

Continuing with a general discussion of system operation, main hard drive 148 and removable hard drive 150 are each capable of storing a predetermined number of alarm image files, transaction image files and transaction data files. In the event that either the main hard or removable hard drive becomes full, new images are written over the oldest images which are present on each respective drive. While the system of the present embodiment is configured to store image and transaction files on main hard drive

148 and removable hard drive 150 directly from temporary image storage sections 140 many alternatives are possible in accordance with the scope of the present invention. For example, image files may be transferred to main hard drive 148 directly from the temporary image storage sections, as above. Thereafter, the image files may be transferred from the main hard drive to the removable hard drive. The removable hard drive may be allowed to remain installed at the ATM for a period of time, continuing to accumulate transaction files and alarm images from day to day until such time that it has nearly reached its storage capacity. At this point, the removable hard drive should be removed.

After the removable hard drive is removed from enclosure 96 via door 103, it is taken to monitoring station 98 or a similar such station. If a review of the images on the transported removable hard drive is necessary, the drive may be placed in removable hard drive bay 132 within computer 116. Image transfer/search program 130 then provides monitoring station operator 134 with complete and random access to transaction data files 156, transaction image files 158 and alarm image files 190 stored by the removable hard drive. Hence, if it is suspected that, for example, a theft may be evidenced by an alarm image and if that act is suspected to have occurred at a particular time, station operator 134 can immediately begin a search for an alarm image captured at that time using random access, as provided by the hard drive in cooperation with image search/transfer program 130. If a particular image satisfies the search requirements entered by the operator, image transfer/ search program 130 will indicate the presence of this particular file to the operator and, upon request, prepare the file for viewing. Thus, operator 134 can quickly move about at will among the captured images. Other features are provided for rapidly locating images. For example, up to ten separate images may be viewed at once along with associated transaction data. If, however, the system operator knows a transaction number or its associated image file name, this information may be either entered directly or selected from an overall directory of transaction and image data for immediate retrieval. These features advantageously avoid the time consuming task of reviewing a large amount of serially recorded analog video information such as would be recorded on a videotape. Additionally, transaction data files may be searched for by date and time based on the name of the file or based on any other information contained

in the file such as, for example, a transaction number. Once the search locates a transaction data file, per these parameters, the system can quickly access the associated transaction image files based upon the previously described file name formats. The located information can then be presented to operator 134 on display monitor 113 in a number of different ways. For example, one tool automatically cycles through all of the images gathered, displaying one image at a time on the operator's display monitor. During cycling, the operator may vary the rate at which the image cycling occurs or terminate cycling with the display of one of the images. Of course, any image and associated transaction data may be printed by printer 121. In addition, files may be saved in well known formats such as, for example, bitmapped images (.BMP) so as to able information distribution and exchange with the authorities or, possibly, other financial institutions. If immediate review of the images present on a particular removable hard drive is not required, the drive can be archived for later reference.

Image transfer/search program 130 also permits random access to information on both the main and removable hard drives from the remote location using modem 118 at the remote monitoring station and modem 180 at the ATM. Access to a particular ATM is gained by calling the ATM on telephone line 119 from computer 116 at the remote location. Program 130 stores site specific configuration information for each ATM that it services. Such information may include, but is not limited to the following: (1) an ATM site ID which may be a unique eight character alphanumeric string, (2) a text description of the location of the ATM, (3) the ATM address, (4) telephone numbers for the modems at the remote monitoring station and at the ATM site, (5) user ID's and passwords which are required for remote access, (6) a problem reporting number through which system malfunctions may be automatically reported, (7) camera ID's including a description of the type of image provided by each camera, for example, an image of the customer's face or a general surveillance image, (8) the number of images which each camera is instructed to capture in response to a transaction event or an alarm event, (9) a list of cameras which are assigned to operate in a surveillance mode, and (10) specification of an inter-image interval between successive surveillance images. All of the information above is also stored on the removable hard drive. Once the modems are linked, operator 134 will typically be required to enter his or her specific user password

prior to being allowed access to the ATM data. Upon entry of the correct password, operator 134 is able to perform searches, view transaction data and view images which are associated with transaction data files in essentially the same manner and using appropriate ones of the tools described above with regard to the removable hard drive. Additionally, the transaction images, transaction files and surveillance images may be selectively transferred to computer 116 at the remote monitoring station by specifying a known file name or a range of file names. For example, the operator may specify a search for all transactions made under a specific card number. The system then searches the transaction data files for that card number. Once the transactions made under that card are identified, the entirety of transaction information available for each identified transaction is made available to the operator. The operator may then order the system to selectively retrieve transaction images in accordance with the file-naming structure described previously wherein the name of the identified transaction data file is used to provide direct and random access to the image file without the need for further data searching. The retrieved images may then be printed, if so desired. In another feature, the system operator may instruct one or more cameras at a specific ATM site to immediately capture images and, thereafter, transfer these images to the remote location for evaluation by the operator. This feature facilitates checking the overall operation of the system and may be useful in other instances as well, for example, if continued monitoring of a particular person present at an ATM is desired.

In addition to the features described immediately above, image transfer/search program 130 includes capabilities for modifying appropriate portions of the ATM site configuration data. For example, new user ID's and passwords may be entered and the number of images captured per camera may be changed, as needed. The changed information is then transferred to the affected ATM site via telephone.

One of ordinary skill in the art will appreciate that the above-described file structure and naming format is highly advantageous within the context of the present invention for a particular reason. Specifically, the speed at which searches may be performed is significantly enhanced. Image data files typically store relatively large amounts of information. For example, high resolution data files, that is 320 by 240 pixels, comprise approximately 10 to 15 kilobytes per image on a hard drive. In contrast,

a transaction data file stores far less information. A typical transaction data file may be as small as 100 bytes. Thus, transaction data may makeup less than 1% of the information stored relating to transactions. By separating the transaction data from its associated image data, system 50 is able to achieve the advantage of efficiently locating images by searching only a fraction of the total amount of data stored on the hard drives. This is particularly advantageous when performing remote searches of data at the ATM from the remote monitoring station since access to the data via modem is reduced by slower data transfer rates. Still further advantages will become apparent in conjunction with the continuing discussion of operational features of the present invention.

System 50 may be configured to process alarm images in any number of different ways. As noted above, ATMs require regular service during which, for example, door 84 of vault 78 is opened. It may be advantageous, at least from the viewpoint of a bank, to record one or more images of anyone who opens vault 84, as a security record. This feature is readily provided by camera 90c in cooperation with intrusion sensor 107, which monitors the vault door. A similar feature is provided by camera 90d in cooperation with intrusion sensor 106 which primarily images service door 60. In cases where alarm images are being used as a security record, the occurrence of an alarm based on intrusion sensors 106 or 107 may not necessitate immediate notification of the remote monitoring station. In fact, the system may be configured to handle these alarm images in different ways at different times. For example, during the ATM's normal operational hours, alarm images responsive to maintenance may simply be recorded locally on the main and/or removable hard drives. These images may then be transferred to the monitoring station (which may be at the bank) at a convenient predetermined time so that security personnel may review the alarm images. Alternatively, alarm images collected at night, when maintenance is not generally performed, may dictate the need for immediate attention. Therefore, these images may be stored locally in addition to being immediately transferred to the monitoring station. Security personnel at the monitoring station may then determine if a response to the alarm is warranted.

In another feature, software control program 154 may be configured to monitor transaction data during its transfer to the hard drives whereby to respond in predetermined ways upon detection of certain information in the transaction data. For

example, virtually every bank or financial institution has a "hot list" of cards which are not valid for various reasons such as being expired, lost or stolen. To that end, a hot list file 192 may be stored on main hard drive 150. The hot list file is transferred from the remote monitoring station to the ATM using image transfer/ search program 130 at regular intervals such as, for instance, each morning whereby to keep the hot list up to date. The cards may be identified in hot list file 192 using account numbers. When a person attempts to use a card which is identified on the hot list, the system captures images, as with a normal transaction. However, other action may also be taken depending on the particular status of the card. For example, if the card is stolen, software control program 154 may immediately initiate transfer of the images to remote monitoring station 98 for review of the images by operator 134. Still further actions may then be instituted. In still another feature, operator 134 may then order the system to continuously capture images of the person who initiated the transaction or, alternatively, the system may automatically capture images for a predetermined period of time. It should be appreciated that this feature provides capabilities in locating cards on the hot list and identifying the users of those cards which have not been seen heretofore. Still further capabilities may be provided in that the system may be configured to capture and transfer images based upon any of the transaction information. As an example, the system may respond to withdrawal transaction amounts which are greater than or equal to a certain threshold amount such as $300.00. A withdrawal transaction above this amount may illicit immediate transfer of images and transaction data to remote monitoring station 98. This threshold amount is presetable within image transfer/search program 130.

The present invention provides other advantages in that various outputs can be provided by software control program 154 via I/O module 160. It is to be understood that these outputs can be used for actuating a wide variety of components including, but not limited to, turning power on or off, activating lighting, activating indicator lamps, actuating remote locking mechanisms and sounding alarm signals. The latter three items are implemented in the embodiment of FIGS. 1 and 2, as indicator lamp 168, remote lock 108 and alarm bell 109. Indicator lamp 168, in the present example, illuminates when the removable hard drive is full. It should be appreciated that the capability for providing

such indications is significant since a monitor or other such display device will not typically be used at the ATM. Other indications may be provided in visual or audio form responsive to virtually any component of the system which may be monitored by software control program 154. For example, the status of main hard drive 148, the cameras, and/or communication with the remote monitoring station may be indicated in a similar manner. The remote lock, described previously, is used in locking customer access door 56. However, it may be moved, for example, to service door 60 or additional locks may be added, as needed. The alarm bell, as noted, may be actuated responsive to unauthorized access to the vault, however, it should be appreciated that the alarm bell may be disabled, actuated responsive to different inputs at different times, or actuated responsive to multiple sensors at the same time. For example, during the day the alarm bell may be disabled. During evening hours, the bell may sound responsive to sensors 106 or 107. At night, when the ATM is closed and customer access door 56 is locked using remote lock 108, the bell may sound responsive to a sensor (not shown) positioned on the customer access door in addition to sounding responsive to sensors 106 or 107. In this regard, it should be appreciated that the system of the present invention provides a great deal of flexibility which is also provided in many other aspects of its operation. For example, system 50 is readily adaptable for use in monitoring more than one ATM at one site by appropriately arranging the cameras and providing separate I/O functions for each machine.

With reference now to the flow chart of FIG. 3 in conjunction with FIGS. 1 and 2, a discussion of system operation in accordance with the features of the present invention will now be provided, beginning with Start step 200. During startup, various system initiation procedures are performed such as, for example, setting global variables and loading interrupt routines. Such procedures are well known to those in possession of ordinary skill in the art and, therefore, will not be discussed in further detail. At step 202, the main program is entered. Step 204 then performs housekeeping in which inputs are monitored and outputs are updated. To that end, indicator lamp 168 is updated by illuminating the lamp if the removable hard drive is full and the arm/disarm status is updated by checking key switch 110 and activating or deactivating the alarm section consistent with the update. Outputs including lock 108 and alarm bell 109 are also

updated. Step 206 is then entered in which the COM 1 buffer is checked for transaction data placed in the buffer by network interface module 101 responsive to a transaction. If there is no transaction data, step 208 is performed. If, on the other hand, there is transaction data in the COM 1 buffer or if card insertion sensor 165 detects the initiation of a transaction, step 210 is next performed in which the transaction processing branch of the program begins by first creating a Date/Time stamp from the real time clock of personal computer 146 for use in naming files in accordance with the file-naming format previously described. Alternatively, as previously described, date and time information for the transaction may be had directly from the transaction data on the ATM network when data is obtained from the COM 1 buffer.

Next, step 212 creates a date directory on the main and removable hard drives in the form C:\DATA\YYYYMMDD, as described. Of course, this directory will be created only once, typically with the occurrence of the first transaction for that date. It is to be understood that when operations are referred to using the "C" nomenclature of the main hard drive that an equivalent step is also performed on the removable hard drive, "D". Generally, the equivalent step for the removable hard drive is performed immediately after carrying out the step for the main hard drive. However, in the alternative, the program may carry out all the steps of transaction processing, presently being described, and then loop through the branch a second time whereby to perform the steps for the removable hard drive. These alternatives are not illustrated herein for purposes of brevity and since they will be understood by those of ordinary skill in the art.

At step 214, the transaction data file, C:\DATA\YYYYMMDD\HHMMC.TRN is opened in transaction data file group 156. Step 216 opens the transaction image files, C:\DATA\YYYYMMDD\HHMMCn.CMP, in transaction image file group 158 for each respective camera wherein "n" indicates the camera number. As previously described, one transaction image file is opened for the image or images captured by camera 90a while another file is opened for the image or images captured by camera 90b. In step 218, the transaction data is written into the transaction data file. Step 220 sends out software command packets including the address of each respective camera (90a and 90b) via COM 2 of personal computer 146 whereby to cause a software initiated forced capture of one or more transaction images by each camera. In addition, step 220

responds to requirements for storage of pre-event images by retrieving temporarily stored and previously compressed images from either the cameras or one of the hard drives, dependent upon the configuration of the system. During step 222, the images captured following transaction initiation are compressed by processing sections 139 of the cameras and stored in temporary storage sections 140. At step 224, the transaction images captured responsive to software command are downloaded onto main hard drive 148 and removable hard drive 150. Thus, transaction processing is completed for one transaction. Thereafter, the system is directed to step 226 which will be described at an appropriate point below.

Turning once again to step 206, the system moves to step 208 if transaction data is not present in the COM 1 buffer of personal computer 146. Step 208 checks for an incoming telephone call on modem 180. If no call is detected, the system goes to step 226. However, if a call is detected, it is answered at step 228. At step 230, a timer is started. Typically, this timer is implemented in software in a manner which is well known in the art and may form part of software control program 154. Step 232 monitors the timer. If the timer times out, the system goes to step 234 and hangs up, having not made a connection with modem 118 at the remote monitoring station. Thereafter, step 236 returns to housekeeping step 204. Until such time that the timer times out, however, steps 232 and 238 form a loop in which step 238 checks for a connection between the modems. If a connection is accomplished, step 240 is performed. Step 240 then checks the data transfer rate at which the modems have connected. If the rate is slower than a predetermined minimum transfer rate, step 234 is performed wherein the system hangs up. Subsequently, connection is reestablished on the next pass through these steps. The predetermined minimum transfer rate may be set, for example, in software control program 154. Since image files may be relatively large, a relatively high minimum data rate such as 9600 BPS may be desirable. If step 240 determines that the data rate is above the minimum, step 244 is next performed in which COM 3 (the port to which modem 180 is connected) is connected with STDIN, which is the standard input for the PC, such that the remote monitoring station can take control of personal computer 146 in a manner which is well known in the art. Before control is relinquished, however, the previously described password is checked in step 244. Once the password is verified, full

control is given to the remote monitoring station at step 246 such that operator 134 can perform searches and transfer images.

Step 226 may be entered following any of steps 208, 224 or 246. Step 226 checks the cameras whereby to ascertain whether they are active or idling. If a camera is active, it may be in the process of compressing an image or the image may be ready for transfer to the main and removable hard drives via personal computer 146. Step 248 determines whether each camera, if it is not idling, has an image ready for transfer. If the image is not ready, a jump to the main program loop at step 204 is made and the image or images will be downloaded on a subsequent pass through these steps. If an image is ready, it is downloaded to personal computer 146 at step 250 and then saved on the main and removable drives in step 252.

At step 254, a determination is made as to whether the alarm section is enabled. As described above, the alarm section in the present example comprises cameras 90c and 90d which may be armed using key switch 110 or, alternatively, remotely from monitoring station 98. If the alarm section is enabled and if alarm images have been recorded, these alarms are reported in step 256 in accordance with the system settings, for example, by immediately transferring one or more alarm images and associated transaction data to the remote monitoring station.

Attention is now directed to FIG. 4 which illustrates a diagrammatic plan view of a second embodiment of a security system, generally indicated by reference numeral 300, constructed in accordance with the present invention. System 300 monitors a first ATM 302 and a second ATM 304. Since ATMs 302 and 304 are similar to ATM 52, which was described in detail in the discussion above, descriptions of like components will not be repeated. For purposes of clarity, however, reference numbers of like components applied to ATM 302 end in an "a" while reference numbers of like components applied to ATM 304 end in a "b". For example, structure 54 for ATM 302 is indicated by the reference number 54a while for ATM 304 the reference number 54b is applied to the structure. System 300 may just as readily be configured to monitor a single ATM. In the case where two ATMs are monitored, the physical separation

therebetween is limited since electrical cabling must run between the two ATMs. Separation between the ATMs is determined by factors such as, for example, signal loss in this cabling.

Still referring to FIG. 4, system 50 includes two video cameras 310a and 310b in ATM 302 which capture images of zones 312a and 312b, respectively. In ATM 304, two video cameras 314a and 314b capture images of zones 316a and 316b, respectively. Cameras 310a and 314a are mounted in a similar manner to camera 90a of the first embodiment, while cameras 310a and 314b are mounted in a similar manner to camera 90b of the first embodiment. However, this particular camera arrangement is not required and may be changed in an unlimited number of ways in view of a particular application. Cameras 310b and 314b are each housed in housings 318 and 320, respectively. The latter housings being similar to housings 94 of the first embodiment. It should also be appreciated that, like system 50, system 300 is configured to respond rapidly to events which require the storage of images, as will be seen hereinafter.

System 300 further includes a component enclosure 322, which is installed at a suitable location within ATM 302 and a remote monitoring station 324 at remote location. It is to be understood that component enclosure 322 may just as readily be located within ATM 304 or, in another alternative, this component enclosure may be housed in an altogether separate structure (not shown) which is configured for this application. For purposes of clarity, component enclosure 322 is shown positioned directly adjacent ATM electronics package 100a. Network data cables 102a,b connect ATM electronics packages 100a,b with network modems 68a,b at ATMs 302 and 304, respectively. A plurality of video cables 326 interconnects cameras 310 and 314 with component enclosure 322. Cables 326 are illustrated only partially since they are readily provided. Moreover, these cables, as with all components of the system located at the ATM, should be hidden and/or arranged in a way which avoids unauthorized access thereto. To that end, underground conduits 328 extending between the two ATMs may be utilized for cables 326 and other signal cables to be described below.

As with system 50, system 300 is adaptable for use with virtually all types of sensors including, but not limited to, door sensors, motion detectors, smoke alarms and any form of contact closure. While not all of the sensors shown and described with

regard to system 50 are depicted as part of system 300, it is to be understood that these sensors are not illustrated in system 300 for purposes of brevity only and that system 300 may readily be configured to include any of these sensors. In the present example, motion detectors 330 and 332 are positioned so as to monitor the ATM customer lobbies. The signal from each motion detector is coupled directly to component enclosure 322 using appropriate, readily provided cables (not shown). As will be described in further detail, system 300 provides a great deal of flexibility in the specified response of the system to sensors such as motion detectors 330 and 332.

Continuing to refer to FIG. 4, remote monitoring station 324 includes previously described display monitor 113, keyboard 114, computer 116, modem 118 connected with standard telephone line 119 and printer 121. The reader is referred to descriptions of these components appearing above, if needed. Reference numbers of other like components at monitoring station 324, which appear above, will also be applied whenever possible. An image control program 327, which is designed in accordance with the present invention, is stored in mass memory 122 of computer 116. The operation of image control program 327 will be described later in conjunction with a general discussion of the overall operational features of system 300.

Having generally described the components which make up system 300, attention is now directed to FIG. 5 in conjunction with FIG. 4. FIG. 5 illustrates, in diagrammatic block diagram form, the internal components of enclosure 322 and the interconnections formed between other components which are located at ATM 302 and/or 304. Each camera 310 or 314 transmits a standard video signal, for example, NTSC or CCIR to a frame grabber board 336 that is connected with a personal computer 338. Frame grabber board 336 is of a type which is known to those of ordinary skill in the art and is readily available. The cameras are labeled as CAM 1 through 4 in FIG. 2. A main fixed disk 340 is interfaced with personal computer 338. If so desired, a removable storage media (not shown for purposes of simplicity), such as removable hard drive 150 of system 50, may also be interfaced with personal computer 338. Main fixed disk 340 stores a basic operating system 342, a control program 344 for controlling the overall operation of system 300 at the ATM site and a directory structure 346 which stores image frames

collected from the cameras along with correlated information in a predetermined and highly advantageous way, as will be described at an appropriate point below.

Continuing with a description of components within enclosure 322, an input/output (I/O) module 348 designed in accordance with the present invention is connected with LPT1 of computer 338. A modem 350 is connected with computer 338 and with a standard switched telephone network line 352. I/O module 348 handles inputs and provides output indications for controlling the system. For example, inputs to module 348 include previously described motion detectors 330 and 332. Two more inputs are provided by card insertion sensors 165a (ATM 54a) and 165b (ATM 54b) which close upon insertion of a card into the card slot on the respective ATM front panels. System 300 may be configured to respond to any of these inputs by storing a predetermined number of image frames per camera. For example, control program 344 may include settings which dictate that a series of four frames is stored which are taken by CAM 1 in response to motion detector 328 wherein each of the frames are separated by one specified interval while, at the same time, CAM 2 captures a series of only two image frames wherein these images are separated by another specified interval. Alternatively, no images taken by CAM 2 may be stored. Thus, it will be appreciated that the number of stored images per camera is advantageously variable at will. Captured image frames are stored in directory structure 346 on main fixed disk 340. I/O module 348, in the present example, is configured to provide three different output indications. Specifically, these include a "Remote Access" lamp 354 which illuminates when the system is communicating with remote monitoring station 324, a "Video Lost" indicator lamp 356 which illuminates when a camera malfunctions, and an "ATM Communication Lost" lamp 358 which indicates that the connection with either of the ATMs has been compromised in some way. Still another output indication is provided by a "System OK" lamp 360 that is coupled to a watchdog module 362 which forms part of I/O module 348 and which will be described below in conjunction with a general description of system operation. It is to be understood that, while these particular inputs and outputs are of significant value, system 300 of the present invention is configured to provide a great deal of flexibility with regard to its I/O capabilities. In this way, the system can be readily configured to accommodate a wide range of I/O applications. For example,

outputs may be used to actuate alarm 109 which was shown and described with regard to the first embodiment, or for power control, also described above.

System 300 further includes one network interface module 101a which is connected to COM 1 of personal computer 338 and another network interface module 101b which is connected to COM 2. Details regarding operation of the network interface module provided for the first embodiment of the invention remain applicable here. During normal system operation, cameras 310 and 314 continuously provide analog video signals to frame grabber 336 of the selected format (NTSC or CCIR). The frame grabber is capable of capturing any individual frame or series of frames at specified intervals for one or more designated cameras, converting the analog frame signal to a digital electrical pixel signal image format and providing the digitized image to computer 338.

Continuing with a description of the operation of system 300, a transaction may be detected by the presence of transaction information in either the COM 1 or COM 2 buffers of personal computer 338. Alternatively, card insertion sensors 165a or 165b may also initiate a transaction in the case where no transaction data is present in the Com port buffers. However, such a transaction event must be handled in a specific way since transaction data is not available from the ATM network. In this regard, further details will be provided at an appropriate point below. Once a transaction is initiated, control program 344 causes personal computer 338 to transfer one or more specified video images from frame grabber 336 to directory structure 346 on main fixed disk 340. System 300 is configured so as to store a predetermined number of images from each camera in accordance with settings stored by control program 344. It is also mentioned that these settings along with many other aspects of system configuration may be changed from remote monitoring station 324 using image control program 327. Additionally, the first image stored in response to a transaction is captured as rapidly as possible following transaction initiation such that this image preferably provides a view of the face of the person initiating the transaction (using cameras 310a and 314a, in the present example). This rapid response is particularly important since transactions may be concluded within a very brief period of time, for example, a transaction may be a minute or less in duration.

Referring now to FIG. 6 in conjunction with FIG. 5, directory structure 346 will now be described. FIG. 6 illustrates a directory tree which corresponds to directory structure 346. During normal operation, program 344 creates a date directory 364 for storing all of the information collected during each day. Directory 364a corresponds to one day while directory 364b corresponds to the day immediately thereafter. The date directory may be named using an eight digit integer. For instance, a date directory corresponding to June 25, 1996 might be named "19960625.???". In the present example, date directory 364 includes first and second ATM sub-directories 336 and 338, respectively, for separately storing data from ATMs 302 and 304. These sub-directories may simply be named "ATM1.???" and "ATM2.???". Two files are stored in each ATM sub-directory. Specifically, one file is a data file 370 which carries a "DAT" file extension while the other file comprises an index control table 372 which carries an "IDX" file extension. Data file 370 and index control table 372 for each day are organized in a cooperative manner which facilitates random and/or direct access to the stored images and associated information using a software tool set 374 forming part of control program 327 provided at remote station 324.

Referring specifically to data file 370, the latter stores all of the digitized images gathered during one particular day using data fields or records. Each video image contained by the data file is stored in a digital image frame format using the fields below:

FIELD NAME	DATA TYPE	DESCRIPTION
FRAME NUMBER	char	frame sequence number
FRAME DATA	char	compressed video image data
FRAME TRAILER	char	frame data terminator

The frame number may be assigned based upon the position of a frame within an overall series of frames. Image data in the "frame data" field may be compressed to form the digital image frame data so as to maximize image storage on main fixed disk 340 using, for example, the previously mentioned Huffman algorithm and, thereafter, stored in the JPEG format. However, it is to be understood that image

compression is not a requirement herein and that video images may be stored in many digitized formats in accordance with the present invention.

In data file 270, image frames which are captured in a sequential series by the same camera are stored in one frame group. Thus, the need for the "frame number" field described immediately above. Each frame group includes a "Camera ID" field which identifies the camera that took the images within the group and a "Frame Total" field which specifies the total number of image frames within the group. For example, a group of four images taken by camera 310a (CAM 1) might be identified by the camera ID field "0001", and the Frame Total field "4".

Each frame group further includes a record header which is composed of the following fields:

FIELD NAME	DATA TYPE	DESCRIPTION
ATM ID	char	ATM where transaction occurred
TIME STAMP	long int	Time string represented as an integer
TRANSACTION TEXT COUNT	int	Number of characters in transaction text string.
TRANSACTION TEXT	char	transaction text
NUMBER OF CAMERAS	char	Number of cameras that captured images
RECORD TRAILER	char	Terminates record header

Much of the information specified by these fields is normally available directly from the ATM network when a transaction occurs, with the exception of "record trailer" and "number of cameras". Information for creating the latter field is available from system configuration data stored by control program 344. The "time stamp" field is a time string converted to an integer value. The "transaction text" field includes the specific details of the transaction. As an example, a record header for a cash withdrawal transaction in the amount of $60.00 processed on ATM 302 which took place at 10:33 p.m. on June 25, 1996, assuming that images are captured by cameras 310a and 310b in response to this transaction, might appear as: 06/25/96 22:33:00 00302 **********7816-004 2222 S. Buckley Record No. 85 Withdrawal $60.00 from checking.

Two frame groups, one for each camera, are referenced by this record header.

Still referring to FIG. 5 and 6, index control table 347 will now be described. In essence, the index control table constitutes a "look-up" table which describes locations of all the fields which make up its related data file. That is, the index control table and data file which occupy the same ATM sub-directory 336. Each index control table includes a time stamp field that is copied directly from the field of the same name appearing in the record header within its associated data file. For the exemplary cash withdrawal transaction above, the time stamp for 10:30 p.m. might appear as the integer "2230". For each time stamp field, the index control table provides a "record offset" field which indicates a position in the related data file specified as a number of characters from the beginning of the data file. These positions mark the beginnings of the fields within the data file. Thus, information contained by a particular field in a data file may quickly be located by first looking up its record offset in the index control table and, thereafter, moving directly to the precise position of the field of interest in data file 370. In this manner, the much slower task of searching the entire data file for the field of interest is avoided.

As noted above, certain images, including those images which are captured in the surveillance or alarm mode, are event triggered and are not associated with the initiation of a transaction on the ATM network. Therefore, record headers for these event triggered images are structured slightly different than record headers described above for transaction images. More specifically, these record headers include the following fields:

FIELD NAME	DATA TYPE	DESCRIPTION
CAMERA ID	char	ID's camera for this frame group
TIME STAMP	long int	Time string as an integer value
EVENT	char	Type of event initiating image aperture
FRAME DATA	char	Compressed video image data
FRAME TRAILER	char	Frame data terminator

While the time stamp fields for these event triggered images may appear as being identical to time stamp fields associated with transaction images, the actual time at which the event occurred must be derived from a source other than transaction data since no information is available from the ATM network for event triggered images. In this particular example, computer 338 includes an internal clock 345 which provides the needed time data. The "event" field, above, indicates specifically what caused the associated images to be captured such as, for example, an alarm event or interval recording of a sequence of surveillance images. Entries in the previously described index record file 372 for event triggered images, like those for transaction images, utilize the time stamp field and associated offset. It is noted that transactions initiated by card insertion sensors 165 include record headers as described immediately above. However, the "event" field therein may specifically indicate that the frame(s) relate to a sensor initiated transaction, as opposed to other types of event images.

Having described directory structure 346, further details of system operation will now be provided. These details primarily relate to system control and access from remote monitoring station 324. It is to be understood that essentially all of the features and tools available at the remote monitoring location and described above with regard to the first embodiment of the invention are also provided for use in this second embodiment. Therefore, many of these descriptions will not be repeated for purposes of brevity. In fact, operation of this embodiment may be indistinguishable from the first embodiment from the viewpoint of the system operator at the remote location. Moreover, any features described solely with regard to the second embodiment are contemplated as readily provided in the first embodiment.

Remote access to system 300 is gained via public telephone line 352. Once the operator has entered a valid user ID and password, remote monitoring station 324 is permitted access to the data stored by main fixed disk 340. Thereafter and as mentioned above, configuration settings contained by control program 344 at the ATM site may be altered using tool set 374. For example, computer 338 may be instructed to store a different number of images for a particular camera and type of event. Remote access also provides for performing system testing without actually having to travel to the physical location of the ATM site. For example, the system operator can

instruct computer 338 to store images from any combination of the cameras at a particular ATM site. These images are immediately transferred to the remote monitoring station and reviewed. In this manner, an out of focus or inoperative camera is readily identifiable.

In one feature, control program 344 is configured to reset a timer 380 which forms part of watchdog module 362 at a regular predetermined interval. In the event that computer 338 ceases to be operational, timer 380 will time out and "System OK" lamp 360 will be extinguished. In response to this occurrence, I/O module 348 may be configured to reboot computer 338. Then, the malfunction can be reported to the remote monitoring station. This feature provides a simple, yet effective method for handling a "locked-up" system which is unattended. As in the first embodiment, other malfunctions such as, for example, main fixed disk failure may be reported to the remote monitoring station or to a station having similar capabilities. Thereafter, the system operator can be notified of the malfunction.

System 300, like system 50, can perform a wide variety of searches of the data stored at the ATM site using image control program 327 at remote station 324. Searches may be based on essentially any of the data recorded at the ATM site. For example, a time range or a range of transaction numbers may be specified. However, it is mentioned that searches are performed most efficiently using the "time stamp" field since every field within the data files of directory structure 346 at the ATM site is correlated with a unique time stamp contained by the index control table. Retrieved images may be displayed as contemplated by the first embodiment and described above. Moreover, tool set 374 facilitates image enhancement, enlargement and other such features. It is also noted that cameras useful herein include either black and white or color cameras.

Operation of system 300 proceeds generally in accordance with the logical sequence depicted by the flow chart of FIG. 3 with only a few exceptions, as follows. In system 50 and as described above with regard to step 226, image compression is performed at the cameras by system 50. In system 300, however, compression is performed by personal computer 146. Additionally, steps 212 through 218 utilize the file structure described above with regard to system 300.

It should be understood that a system for monitoring an ATM may be embodied in many other specific forms and modified in an unlimited number of ways without departing from the spirit or scope of the present invention. For example, forms of storage media other than hard drives may be found to be useful with the present invention including, for example, properly configured RAM modules such that images may be stored in RAM without the need for a hard drive or such similar media. As another example, it is anticipated that improved imaging and faster data transfer rates may provide the system of the present invention with the capability of supplying full motion video or its equivalent at the remote monitoring station. Therefore, the present examples are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope of the appended claims.